

Volume 1. 384-391. p. Brighton, England

K. SÁGI, M. NÁDASY, L. SZABÓ, A. VASS

Research Institute for Heavy Chemical Industries, Veszprém, Hungary.

NE-79168, S-[N-2-Chlorophenyl-butylamido]methyl O, C-dimethyl phosphorodithioate is a new insecticide now being developed primarily against a very wide range of phytophagous insects, including Physopa, Hemiptera, Coleoptera, Lepidoptera, Diptera and Hymenoptera.

INTRODUCTION

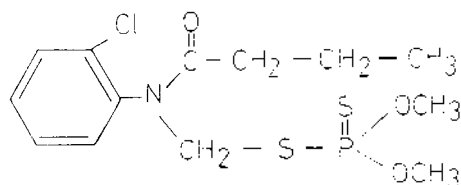
NE-79168 was the most effective of a number of similar compounds investigated.

CHEMICAL AND PHYSICAL PROPERTIES

Chemical name: S,[N-2-Chlorophenyl-butyrarnido]methyl S, S-dimethyl phosphorodithioate.

Structural formula:

Fig. 1. The structural formula of NE-79168 is:-



Molecular formula: $C_{13}H_{19}ClNO_3PS_2$

Molecular weight: 367.86

Physical state: white, crystalline material

Melting point: 42°C

Solubility in water: 2.3±0.4mg/litre at 20°C

Hydrolysis rates: Half-life in hours

pH	20°C	37°C
4.5	12.7	6.6
7	13.1	5.4
8.3	11.4	5.4

Vapour pressure: $9 \pm 0.6 \times 10^{-5}$ mm Hg at 20°C

Partition coefficient: 4-octanol:water $P = 3.6 \pm 0.2$

Formulation: e.c. 565 g a.i./litre

TOXICOLOGY

Some of the toxicological investigations necessary for the registration of NE-79168 have been done by the Institute and others are in progress.

Toxicity to birds

Tests were conducted to determine the acute oral LD_{50} and the 8-day dietary LC_{50} values for 4-wk-old pheasant chicks (Phasianus colchicus) and Japanese quail (Coturnix coturnix japonicus), the acute oral LC_{50} values being 92 mg a.i./kg body wt. for pheasant chicks and 68-74 mg a.i./kg for quail. The LC_{50} values in the diet were 1330 and 11 250 mg a.i./kg for pheasants and for adult female quail respectively.

Toxicity to fish

The LC_{50} (96 h) for carp (Cyprinus carpio) was 6 mg a.i./litre and for goldfish (Carassius auratus) 12 mg a.i./litre.

TABLE 1

Summary of the acute toxicity of NE-79168 to the albino rat (Rattus norvegicus LATI:Wistar), the albino mouse (Mus musculus LATI:NMRI) and the albino rabbit (Cryptolagus curiculus KORNYE:NZW)

Method of administration	Animal	LD_{50} active ingredient (mg/kg)	Formulation 50% e.o. (mg/kg)
Oral	rat, male	110	187
	female	49	82
	mouse, male	129	81
	female	116	97
Dermal	rat, male	>11 000	7800
	female	6000	5900
Inhalation	rat, male	>15 000 mg/m ³	>35 000 mg/m ³
Intraperitoneal	rat, male	95 µg/kg	
	female	73 "	
Topical: skin eye	rabbit	slight irritation	
	rabbit	slight irritation	

LABORATORY AND GLASSHOUSE TESTS

For arthropod species used in laboratory and glasshouse experiments compound sprays were applied to run-off and plants were artificially inoculated.

Our tests showed that NE-79168 was highly effective primarily against chewing insects under laboratory conditions. The comparison with different standards gave similarly good results (Table 2).

2C-S13

TABLE 2

Efficacy of NE-79168 against diamond-back moth (*Plutella xylostella*) and mustard beetle (*Phaedon cochleariae*) in laboratory experiments in Hungary, 1982

Active ingredient or Product	Formulation	% mortality 24 h. after spraying with 32 mg a.i./litres		
		Mustard beetle		Diamond-back moth
		adult	3rd instar larvae	3rd instar larvae
Heptenophos	e.c.	80	100	100
Methidathion	w.p.	0	60	50
Monocrotophos	w.s.c.	45	80	15
Parathion-methyl	e.c.	100	100	100
Phosphamidon	s.	45	95	10
Pirimiphos-methyl	e.c.	95	100	95
Thiocyclam	s.p.	0	56	90
Trichlorphon	w.p.	38	85	95
NE-79168	e.c.	80	100	100
Untreated		0	0	0

FIELD TRIALS

Results from representative field trials from 1979 to 1982 are summarized.

Winter oil seed rape (*Brassica napus*)

Tests have been conducted on plots of from 5 to 40 ha. The compound was applied by various types of ground equipment or by helicopter. The spray volume for ground machines was 150-400 litres/ha and for helicopter 50-90 litres/ha. NE-79168 50% e.c. was applied in all trials at rates of from 280 to 560 g a.i./ha.

The compound was effective against pollen beetle (*Meligethes aeneus*), cabbage seed weevil (*Ceutorrhynchus assimilis*), cabbage stem weevil (*C. quadridens*) and turnip sawfly (*Athalia rosae*) at 336 g a.i./ha (Table 3).

Alfalfa (*Medicago sativa*)

280-560 g a.i./ha NE-79168 50 e.c. was applied on plots of 1 to 25 ha, using various types of ground machine, at 120 to 600 litres/ha, and by helicopter at 50-90 litres/ha spray.

NE-79168 provided excellent control against several foliar (Table 4) and seed-damaging pests of alfalfa, including leaf beetle (*Phytodecta fornicata*), clover weevils (*Sitona* spp.), trefoil leaf weevil (*Hypera punctata*), *Tychius flavus*, plant bugs (*Lygus rugulipennis*, *L. pratensis*, *Adelphocoris lineolatus*), the chalcid *Bruchophagus* (*Eurotoma*) *roddi*, and *Heliothis maritima*.

TABLE 3

Effect on pollen beetle, cabbage seed weevil, cabbage stem weevil, turnip sawfly infestations 5 days after the first application on winter oil seed rape in Hungary 1982

Treatments	Dose (g a.i./ha)	% control of			
		Pollen beetle	Cabbage seed weevil	Cabbage stem weevil	Turnip sawfly
NE-79168 (e.c.)	336	77	72	92	100
NE-79168 (e.c.)	392	95	-	94	-
Parathion-methyl (e.c.)	400	70	42	94	100
Phosalone (e.c.)	612	68	-	-	-
Endosulfan (w.p.)	428	57	46	-	-
Untreated*	-	(37)	(7)	(15)	(227)
No. of trials		4	2	2	2

* = Mean number of the pest on the sampled area in the untreated plots

TABLE 4

Effect on clover weevil and Heliothis maritima infestations 6 days after application to alfalfa, Hungary 1982

Treatments	Dose (g a.i./ha)	% control of	
		clover weevil	<u>H. maritima</u>
NE-79168 (e.c.)	452	82.8	92.8
Guinalphos (e.c.)	250	85.9	93.9
Untreated*	-	(8.2)	(16.8)

*Mean number of the pest on the sampled area in the untreated plots

Apple (Malus silvestris)

Extensive testing was carried out at various sites, to assess the effectiveness of NE-79168 against the complex of foliar pests in apple orchards. Tests were performed on plots of 0.5 to 1.5 ha with various types of field equipment applying 800 to 1500 litres/ha. Depending on the pests present on the experimental sites, five to nine applications were made. The rates applied, 560-1120g a.i./ha, gave excellent results against codling moth (Cydia pomonella) (Table 5) and also tortrix moths (Pandemis ribeana, P. heparana, Adoxophyes reticulana, Archips podana, Heydia nubiferana), bud moth (Spilonota ocellana), winter moth (Operopthera brumata), umber moths (Erannis spp., Boarmia spp.), blister moths (Phyllonorycter (Lithocolletis) blancardella, P. corylifoliella, Leucoptera scitella), and apple pigmy moth (Nepticula malella).

Other crops

Species successfully controlled on other crops treated with 280 to 1680 g a.i./ha NE-79168 50 e.c. are summarized in Table 6.

2C-S13

TABLE 5

Percentage reduction in fruit damage by codling moth (*Cydia pomonella*) on apple, Hungary 1982

Treatment a.i.	Formulation	No. of trials	Dose (g a.i./ 100 litres)	% Reduction in fruit damaged
NE-79168	e.c.	6	56	89
NE-79168	e.c.	6	84	94.6
NE-79168	e.c.	6	112	99
Methidathion	w.p.	3	40	99
Azinphos-methyl	w.p.	5	50	97
Trichlorphon	w.p.	2	100	92
Phosphamidon	s.	1	50	76
Quinalphos	e.c.	1	50	95
Mean % damaged fruit on untreated controls (range)				15.8 (4.3-39)

Toxicity to the Honeybee (*Apis mellifera*)

Test on flowering crops were performed according to the standard methods in Hungary (Benedek, 1981). Large-scale field trials were conducted using 5-25 ha plots to which the treatments were applied in the evening after the daily flight time of bees.

395 to 565 g a.i./ha was applied as 0.7 litres NE-79168 50% e.c./ha. For comparison, thiocyclam was applied to another plot at 450 g a.i./ha (0.5 kg Evisect 90% s.p./ha), both treatments being sprayed onto the crops at 50 litres/ha with helicopter.

According to data collected from dead-bee traps in May 1982 (Fig. 2) 395 NE-79168/ha applied as 0.7 litre formulated product in 50 litres/ha did not significantly affect bee colonies placed on the site. There was no marked difference in brood assessment or in the behaviour of foraging bees between the colonies on this site and those placed on untreated areas or on those plots receiving the standard treatment.

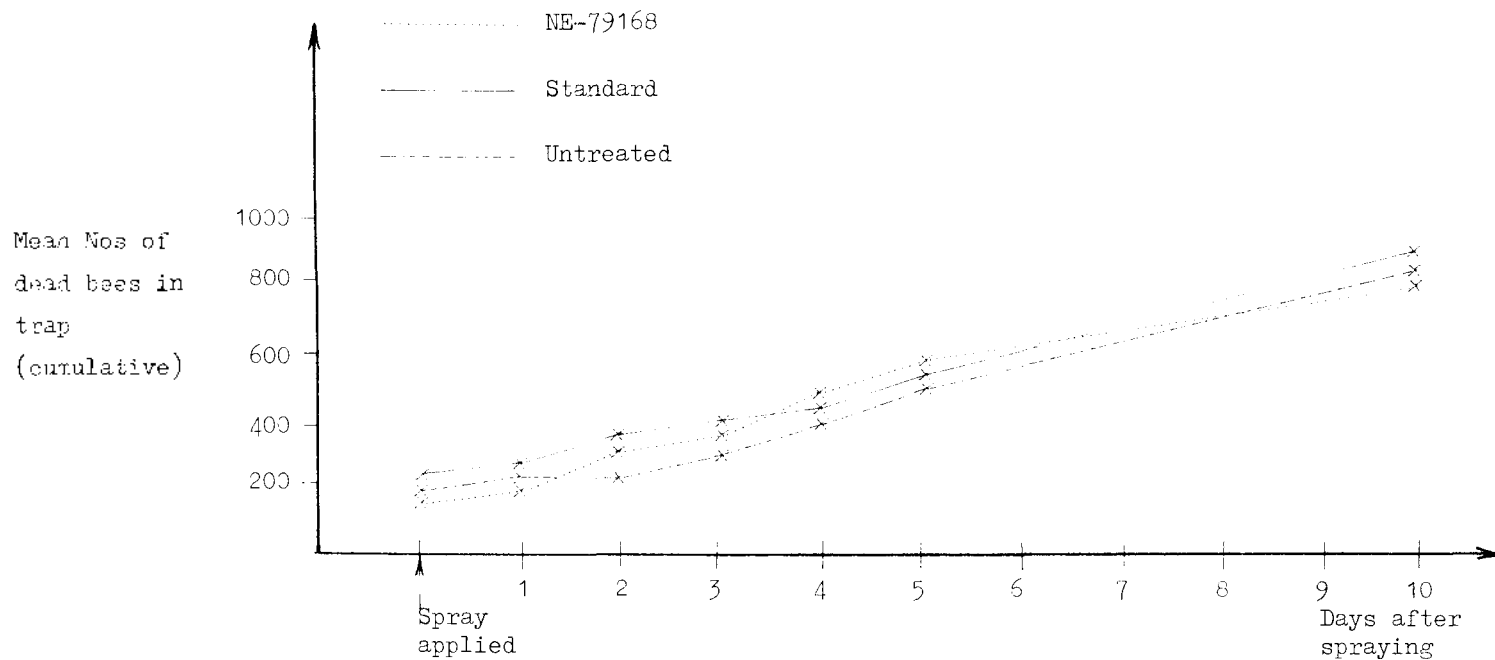
TABLE 6

Effectiveness of species controlled by NE-79168 on various crops

Crop	Pest	Dose of NE-79168 (g a.i./ha)	% control obtained
Winter wheat (<u>Triticum aestivum</u>)	Corn ground beetle (<u>Zabrus tenebrioides</u>)	560	80-90
Sugar beet (<u>Beta</u> spp.)	Flea beetle (<u>Chaetocnema tibialis</u>) Cabbage moth (<u>Plutella brassicae</u>) Silver y moth (<u>Autographa gamma</u>) Cutworms (<u>Agrotis</u> spp.)	560-840	85-100
Flax (<u>Linum usitatissimum</u>)	Large flax flea beetle (<u>Aphthorae euphorbiae</u>)	280-560	90-100
Pump (<u>Cannabis sativa</u>)	Weevil (<u>Curculionidae rapae</u>)	280-560	90-100
Lupin (<u>Lupinus</u> spp.)	Clover (<u>Sitona griseus</u>)	280-560	90-100
Onion (<u>Allium cepa</u>)	Onion thrips (<u>Thrips tabaci</u>)	280-560	90-100
Pea (<u>Pisum sativum</u>)	Pea and bean weevil (<u>Sitona</u> spp.) Cabbage moth (<u>Plutella brassicae</u>) Tomato moth (<u>Lacanobia cloraceae</u>) Silver y moth (<u>Autographa gamma</u>) Lima-bean pod borer (<u>Etiella zinckenella</u>)	560-840	85-100
Peach (<u>Prunus persica</u>)	Peach twig borer (<u>Anarsia lineatella</u>) Oriental fruit moth (<u>Cydia molesta</u>) Leaf weevils (<u>Phyllobius</u> spp.)	560-1120	90-100
Plum (<u>Prunus domestica</u>)	Plum fruit moth (<u>Cydia funebrana</u>)	560-1120	90-100
Grape (<u>Vitis vinifera</u>)	Grape berry moth (<u>Clypea ambiguella</u>) European vine moth (<u>Lobesia botrana</u>)	840-1680	85-98
Cotton (<u>Gossypium</u> spp.)	Cotton leafworm (<u>Alabama argillaceae</u>)	280-560	92-99

Figure 2.

Dead bees collected after NE-79168 and thiocyclan applied to winter oil seed rape. Hungary, May 1982.



CONCLUSIONS

Promising results have been obtained with the insecticide NE-79168 50 EC, which is now under development having been effective against insect pests in 33 Families representing 7 Orders (Table 7). A main advantage of the product is the fact that it can be safely used in the evening during periods when crops such as winter soil seed rape are in flower and being visited by bees.

TABLE 7

Important insect groups, against which NE-79168 was effective in glasshouse, laboratory and field tests

Order	Family
Physopoda	Thripidae
Heteroptera	Scutelleridae, Pentatomidae, Miridae
Homoptera	Cicadellidae, Cecopidae, Psyllidae, Aphididae Lecaniidae, Diaspididae
Coleoptera	Coccinellidae, Nitidulidae, Chrysomelidae, Eruchidae, Curculionidae, Apionidae
Lepidoptera	Tineidae, Plutellidae, Gelechiidae, Hyponomeutidae Tortricidae, Phycitidae, Phyalidae, Pyraustidae, Geometridae, Noctuidae, Lymantriidae, Arctiidae, Pieridae
Diptera	Cecidomyiidae
Hymenoptera	Pamphiliidae, Tenthredinidae, Eurytomidae

REFERENCES

- Benedek, P. (1981). Peszticidek veszélyessége a beporzó méhekre és
kimélesük lehetőségei a nagyüzemi gazdálkodás keretei között.
Nemzetközi Mezőgazdasági Szemle 25, 47-54.